

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2018/2019

TCV3151 – COMPUTER VISION

(All sections / Groups)

19 OCTOBER 2018

9.00 a.m. – 11.00 a.m.

(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 6 pages with 5 questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please print all your answers in the answer booklet provided.

QUESTION 1

- (a) Describe two specific applications in which computer vision techniques have been used successfully. Specify in some detail the techniques used in each case. [4 marks]
- (b) Figure 1.1 shows the progressive results of quantizing a gray-level image.

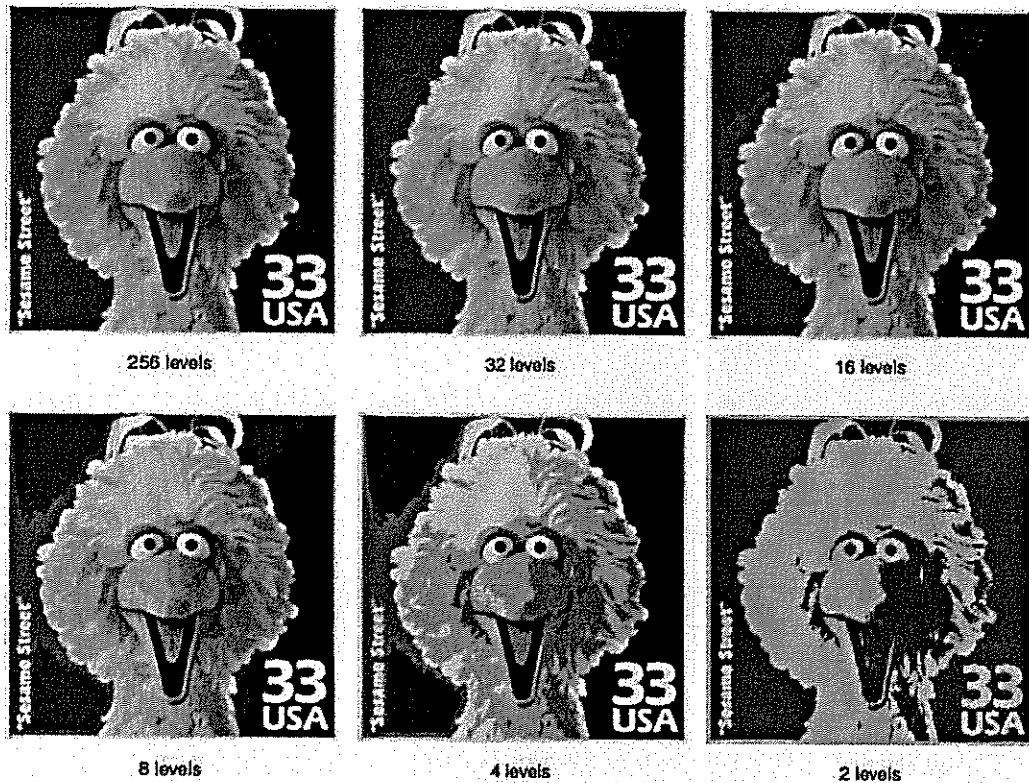


Figure 1.1

- (i) What is quantization in digital image processing? [1 mark]
- (ii) What affects do you observe when the quantization levels are reduced in Figure 1.1? [2 marks]
- (iii) Do you think quantization is reversible? [1 mark]

Continued

- (c) Name the type of connectivity (i.e. 4-connectivity or 8-connectivity) for the following figures. [2 marks]

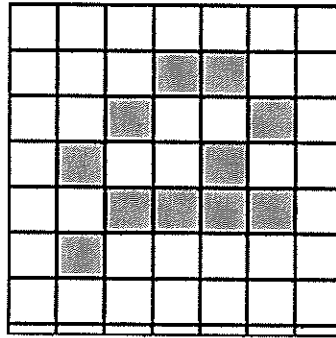


Figure 1.2

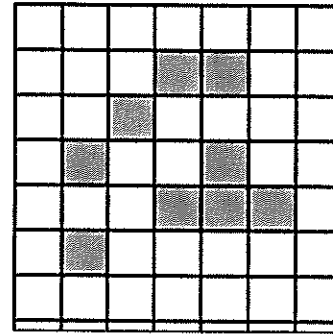


Figure 1.3

Continued

QUESTION 2

- (a) Image enhancement approaches fall into two broad categories. Explain the approaches in the two categories. [2 marks]
- (b) Consider the original image depicted in Figure 2.1. Explain the point processing operation could have been applied to obtain the result shown in Figure 2.2. Plot the point processing operation. [3 marks]

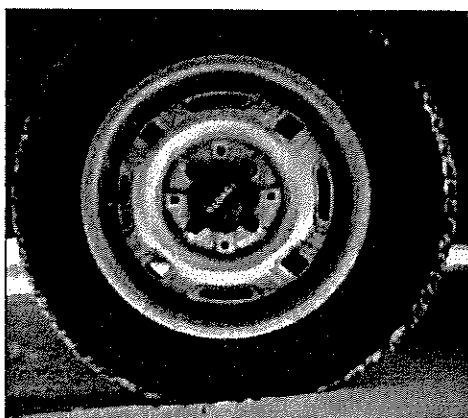


Figure 2.1

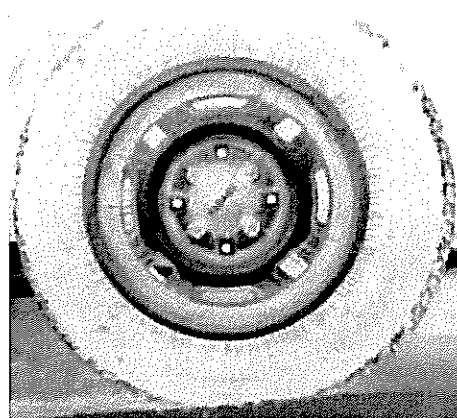


Figure 2.2

- (c) Histogram processing is one of the key techniques used in digital image processing.
- (i) Define histogram. [1 mark]
- (ii) What is meant by histogram equalization? [1 mark]
- (iii) Apply histogram equalization on a 4-by-4 digital image in 8 gray levels shown in Figure 2.3. Sketch the histograms before and after applying histogram equalization on the image. [3 marks]

6	7	5	6
6	4	5	5
4	7	0	5
5	6	5	5

Figure 2.3

Continued

QUESTION 3

- (a) Give the difference between image enhancement and image restoration. [2 marks]
- (b) A 3-bit image of size 4-by-4 is shown in Figure 3.1.

1	4	5	1
2	2	4	2
1	0	1	0
1	2	1	0

Figure 3.1

- (i) Apply a 3×3 average filter on the image. Extend the border values outside with values at the boundary. [2 marks]
- (ii) Assume that the image in Figure 3.1 is corrupted with a considerable amount of salt and pepper noise. Do you think average filter can remove the salt and pepper noise effectively? Why? [2 marks]
- (iii) Do you think median filter can be better than average filter in removing the salt and pepper noise? Why? [2 marks]
- (c) Figure 3.3 depicts the output of enhancing Figure 3.2 using a Laplacian filter. Figure 3.4, on the other hand, represents the output of applying a Gaussian filter before applying the Laplacian filter on the original image. Which output is more appealing (Figure 3.3 or Figure 3.4)? Why? [2 marks]



Figure 3.2



Figure 3.3



Figure 3.4

Continued

QUESTION 4

- (a) Define an edge. State the goal of edge detection. [2 marks]
- (b) Consider an image containing strong illumination gradient shown in Figure 4.1. The histogram for this image is given in Figure 4.2.

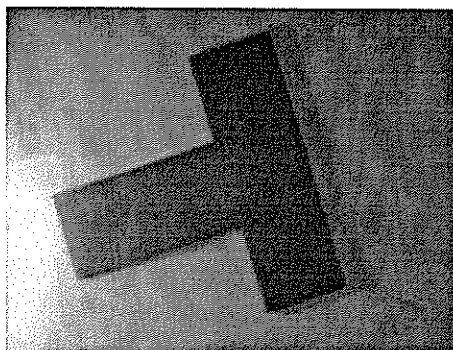


Figure 4.1

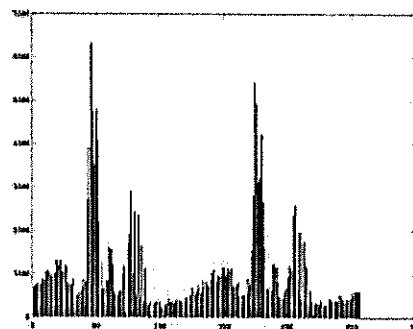


Figure 4.2

- (i) What is the problem related to choosing a suitable threshold for this image? [1 mark]
- (ii) Propose a suitable method that could be used to perform successful segmentation for this image. [2 marks]
- (c) Explain how gray-level co-occurrence matrix (GLCM) can be used for texture analysis. [2 marks]
- (d) Given a sequence of images showing the movement of an object through four frames illustrated in Figure 4.3. Find the Accumulative Difference Pictures (ADP) for these image frames. The α_i values have been given for each frame. [3 marks]

1	1	1	0
0	1	1	0
0	1	1	1
0	0	1	1

0	1	1	1
0	0	1	1
0	0	1	1
0	0	0	1

$$\alpha_2 = 2$$

0	0	1	1
0	0	0	1
0	0	0	1
0	0	0	0

$$\alpha_2 = 4$$

0	0	0	1
0	0	0	0
0	0	0	0
0	0	0	0

$$\alpha_3 = 6$$

Figure 4.3

Continued

QUESTION 5

- (a) Why do you think intra-class variation and deformation pose great challenges to object recognition? Explain your answer. [2 marks]
- (b) True/False: Given a set of three images shown in Figure 5.1, finding and labelling the image in the centre as “containing a cat” is considered a detection task in object recognition. Justify your answer. [2 marks]

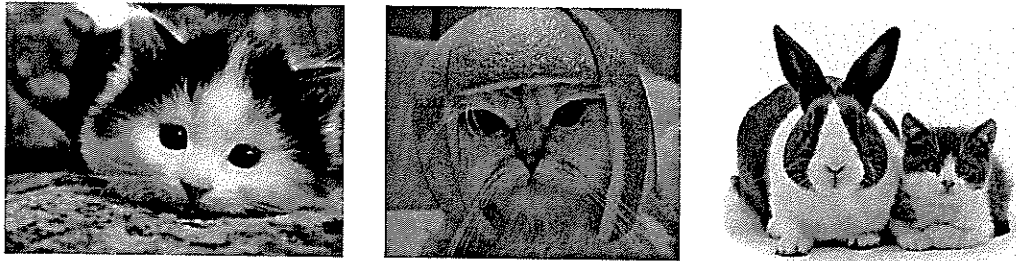


Figure 5.1

- (c) Many computer vision algorithms such as SIFT (scale-invariant feature transform) seek to detect and analyse features at multiple scales of analysis.
- (i) List FOUR characteristics of the features extracted by SIFT. [2 marks]
- (ii) Do you think Difference of Gaussian images are equivalent to the Laplacian of Gaussian? Justify your answer. [2 marks]
- (iii) Briefly describe how the SIFT features can be used for object recognition. [2 marks]

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